Technical Note

Open Medial Meniscotibial Ligament Repair With Concomitant Open Superficial Medial Collateral Ligament Repair With Internal Brace Augmentation

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Abstract: The medial collateral ligament (MCL) is the most commonly injured ligament in the knee. Historically, nonsurgical management for these injuries has been favored for a majority of grade I-III sprains, particularly femoral-based. However, when coupled with other injuries such as meniscotibial ligament tears or distal Stener type avulsion tears, early surgical management for these cases is recommended. This will allow for stabilization and protection of the meniscus in addition to preventing residual valgus laxity, especially related to more severe Stener-like avulsions of the superficial MCL that can be seen with meniscotibial ligament tears. Utilizing an open approach, meniscotibial repair with suture anchors with internal brace augmentation for the MCL repair can provide a strong final construct, and a safe and fast recovery.

The medial collateral ligament (MCL) is the most commonly injured knee ligament, accounting for approximately 40% of all ligamentous knee injuries.[1,2] Despite it being the most commonly injured, it is not the most common knee ligament treated operatively due to the inherently stable nature of a majority of MCL sprains occurring without other ligamentous injury.[3] However, for certain grade III MCL tears, especially distal Stener-type MCL avulsions off the tibia, surgical intervention is necessitated to restore proper knee biomechanics by correcting persistent valgus instability.[4,5] In addition, injury to the meniscus through its meniscotibial attachment further destabilizes the medial side.[4-7] Injury to the medial meniscotibial ligament (MTL) may be seen on magnetic resonance imaging as meniscal extrusion with possible entrapment of the MCL underneath it.[4] Arthroscopically, an MTL injury has been described as a "meniscal rise."[8] If left untreated, this may lead to the accelerated progression of osteoarthritis in the medial compartment due to excess contact pressures shifting from the medial meniscus to the medial tibial plateau (MTP).[5-7] Therefore, restoring proper medial meniscal anatomy and function is necessary, as the MTL plays a crucial role in meniscal stability and intra-articular chondral preservation.[5-7,9]

The described technique is based on independent fixation of both the MTL injury and the distal superficial medial collateral ligament (sMCL) avulsion. Specifically, the MTL injury is first fixated with 2 suture anchors placed into the proximal tibia followed by repair of the sMCL with a combination of suture anchor and internal brace fixation. This procedure provides an additional technique to address the concurrent MTL and sMCL lesions with a strong construct that is restores normal anatomy (Video 1 and Table 1).

Surgical Technique (With Video Illustration)

Step 1: Patient Setup and Diagnostic Arthroscopy

The patient is positioned supine on a standard operative table. Following thorough examination under

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Table 1. Pearls and Pitfalls

Pearls	Pitfalls
• Dissect the saphenous nerve and protect throughout the procedure • Preserve the layers of the medial aspect of the knee to allow for proper closure • Identify the proper location of the isometric point of the femur on a perfect lateral radiograph • Tension the sMCL suture tape at 15° knee flexion	• Injury to the saphenous nerve or vessels on dissection • Placement of MT fixation anchors to close to the joint itself • sMCL tissue may not be amenable to primary fixation due to location of tear or quality of tissue • Overtensioning the medial side of the knee with *Internal*Brace (Arthrex) augmentation

MT, meniscotibial; sMCL, superficial medial collateral ligament.

anesthesia, the knee is prepped and draped in the normal fashion with 2 g of Kefzol (cefazolin) administered before surgical timeout.

Standard anterolateral and anteromedial arthroscopy portals are created, and a diagnostic joint assessment is performed. Immediately upon entering the medial compartment, a positive "drive-through" (Fig 1A) sign is noted with an associated high-riding meniscus consistent with combined MTL and sMCL injury (Fig 1B).

Step 2: MCL, MTL Dissection

A longitudinal incision is made just proximal to the medial joint line along the sMCL and is extended 6 cm distal to the joint to the expected sMCL footprint.[9] The sartorius fascia is carefully incised and the infrapatellar branch of the saphenous nerve is identified and protected for the remainder of the procedure (Fig 2).

Typically, findings include a complete avulsion of the sMCL off its tibial insertion consistent with a Stener-type lesion with associated meniscotibial disruption. As the sMCL is elevated, a complete disruption of the medial MTL is easily visualized (Fig 3).

Step 3: Meniscotibial Fixation

Using a 1.35-mm K-wire drill, a double-loaded 1.3-mm anchor (DX FiberTak with 0.9-mm SutureTape with needles; Arthrex, Naples, FL) is inserted into the proximal tibia at the posterior aspect of the MTL defect just below the joint line. The 2 SutureTape ends are passed through the peripheral aspect of the medial meniscus in a horizontal mattress fashion and left untied. These steps are repeated with a second anchor placed more anteriorly. The SutureTapes are then tied reducing the medial meniscus back to the tibia (Fig 4).

Step 4: Femoral MCL Fixation

Next, using fluoroscopy, the isometric point for MCL femoral fixation is identified on the true lateral projection of the knee located at the junction of the posterior femoral cortical line and the upper aspect of Blumensaat's line (Fig 5).

If the patient is not skeletally mature, care is taken to ensure that the guidepin position is just distal to the growth plate with fluoroscopic confirmation. A 2.4-mm guidepin is then inserted to a depth of 25 mm and over-reamed with a 4-mm reamer to a depth of 20 mm. To breach the femoral cortex, a 4.75-mm anchor tap is used for at least 3 turns. A 2-mm-wide suture tape (FiberTape; Arthrex) is passed through the eyelet of a 4.75-mm bioabsorbable anchor (BioComposite SwiveLock; Arthrex), thus creating the internal brace construct (*Internal*Brace; Arthrex).[10] The SwiveLock is

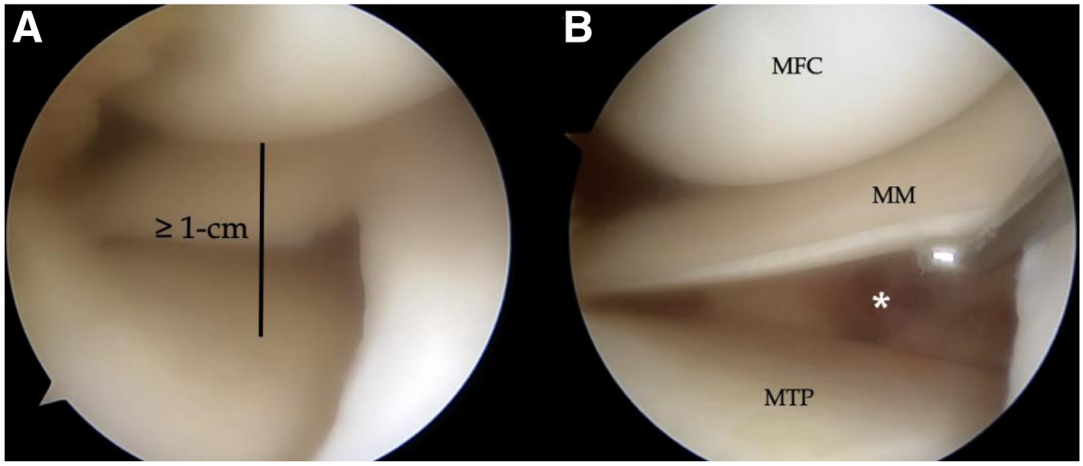

Fig 1. Arthroscopic viewing of the right knee from the anterolateral portal demonstrating (A) a positive drive-through sign (≥1-cm medial compartment opening) and (B) a "high-riding" medial meniscus (MM) and a hemorrhagic meniscotibial ligament (asterisk) suggestive of complete disruption. (MFC, medial femoral condyle. MTP, medial tibial plateau.)

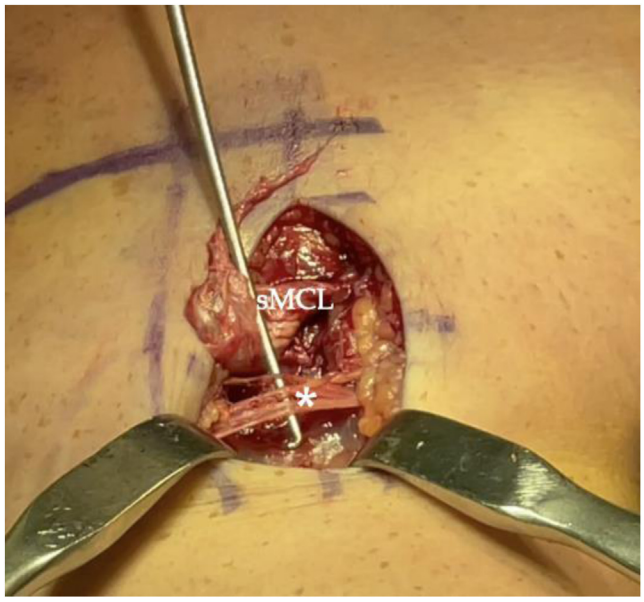

Fig 2. Intraoperative photo of the right medial knee demonstrating the infrapatellar branch of the saphenous nerve (asterisk) following medial dissection. (P, probe; sMCL, superficial medial collateral ligament.)

tapped with a mallet into the femoral socket until the eyelet is fully seated and then screwed to just below the femoral cortex.

Step 5: Tibial MCL Fixation/Closure

Next, at the distal aspect of the incision, the pes tendons are retracted inferiorly, allowing visualization of where the sMCL had avulsed from its normal tibial footprint. A 2.4-mm guidepin is inserted here at a depth of 25 mm. A 4-mm reamer is used to over-ream at this point the same way as described previously for the femur. A 4.75-mm anchor tap is used to completely tap this hole. Using a curved hemostat, the sMCL is carefully passed under the infrapatellar branch of the saphenous nerve and extended toward the tibial bone socket as is the suture tape that laid superficial to the ligament but deep to the nerve. The 2 FiberTape ends are passed through the eyelet of a 4.75-mm bioabsorbable anchor with a knotless mechanism (DX Knotless SwiveLock, BC, 4.75-mm; Arthrex). With the knee positioned at 15° of flexion, the anchor is pushed through the sMCL and into the tibial bone socket, repairing the sMCL avulsion in the process as it is screwed down. As the anchor is inserted, a probe is placed under the FiberTape just distal to the nerve to prevent excessive tension of the internal brace. The repair suture of the knotless mechanism is then passed in a horizontal mattress fashion through the distal sMCL fibers and then further secured to the bone underneath the suture tape by passing this same suture through the loop of the knotless mechanism creating a splice as it is tightened down with the remaining free suture. The #2 FiberWire (Arthrex) suture attached to the femoral anchor is passed through the sMCL proximally to plicate and tighten its femoral attachment. With the knee held at 30° of flexion, valgus stress is applied to the knee confirming adequate stability following the repair. Final anatomic sMCL repair can be seen in Figure 6.

With the arthroscope in the anterolateral portal and the probe in the anteromedial portal, the final repair of the MTL is inspected. The medial meniscus laid flush against

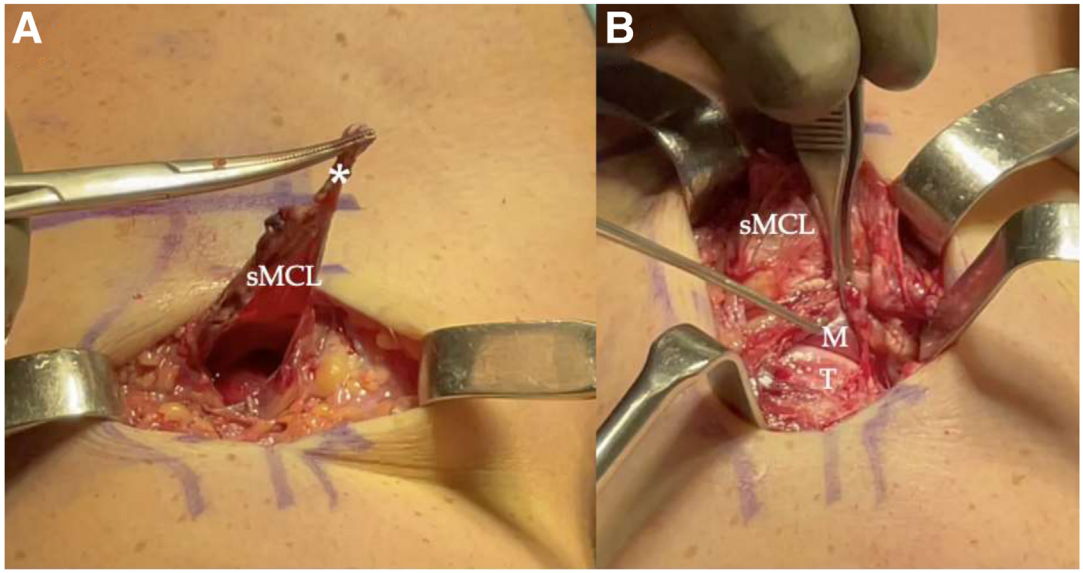

Fig 3. Intraoperative photograph of the right medial knee demonstrating a (A) distal Stener avulsion lesion (asterisk) of the superficial medial collateral ligament (sMCL) off the tibia, and of a (B) complete disruption of the meniscotibial ligament with no attachment of the meniscus body (M) to the tibia (T).

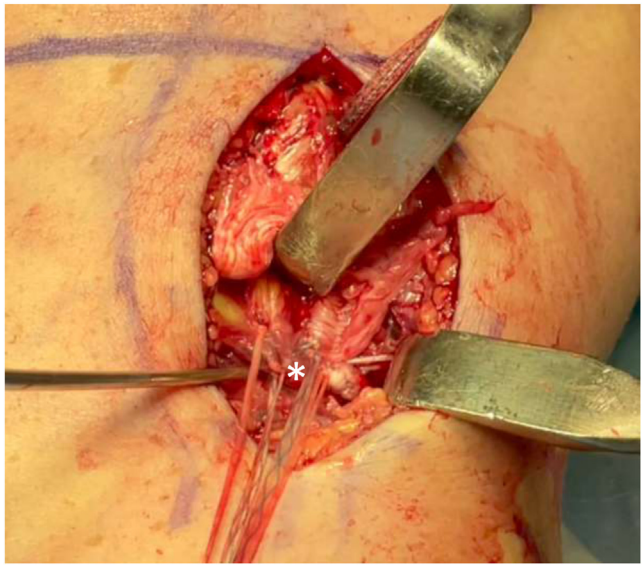

Fig 4. Intraoperative photograph of the right medial knee following meniscotibial ligament repair (asterisk) using 2 anchors and 4 sutures.

the MTP confirms normal anatomical positioning. It is also noted that the "drive-through" sign is eliminated, confirming adequate repair of the MCL (Fig 7)

The tourniquet is released, and the medial incision is adequately irrigated with Betadine followed by antibiotic saline solution. The wound is then closed in a standard, layered fashion and a sterile, bulky compressive dressing is applied to the knee along with a long leg hinged knee brace locked in full extension.

Fig 5. Lateral fluoroscopic image of a right knee in a near skeletally mature individual demonstrating the guide pin (asterisk) placed at the junction of the posterior cortical line and the upper aspect of Blumensaat's line (B) for isometric positioning for the femoral sMCL attachment. (sMCL, superficial medial collateral ligament; P, distal femoral growth plate.)

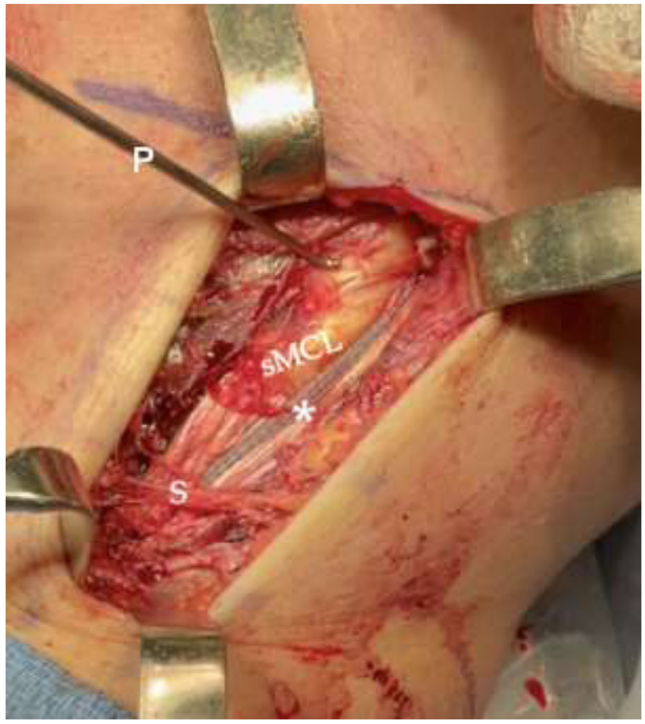

Fig 6. Intraoperative photograph of the right medial knee demonstrating final anatomic superficial medial collateral ligament (sMCL) repair with suture tape augmentation (asterisk). (P, probe; S, infrapatellar branch of the saphenous nerve.)

Step 6: Rehabilitation

An accelerated rehabilitation protocol is implemented following the procedure. A long-leg brace locked in extension is used for the first 2 weeks to allow for protected weight-bearing. Range of motion for flexion along with quad sets and straight leg raises begins postoperative week 1. Use of the stationary bike and addition of leg press and hamstring curls begins postoperative week 2 along with protected weight-bearing in the same long-leg brace with the hinges open to 90°. Continued supervised physical therapy in a smaller hinged brace begins postoperative month 2 with a focus on closed-chain strengthening. Swimming (without leg kicking) with a floatation device between legs is permitted at this point. Jogging is typically allowed by postoperative month 3, with more intense running and cutting allowed at month 4 per physical therapy's recommendation. Full return to sport in a functional knee is in the range of 4 to 6 months.

Discussion

MTL lesions lead to meniscal rise and extrusion.[4] An extruded meniscus allows contact pressures to shift

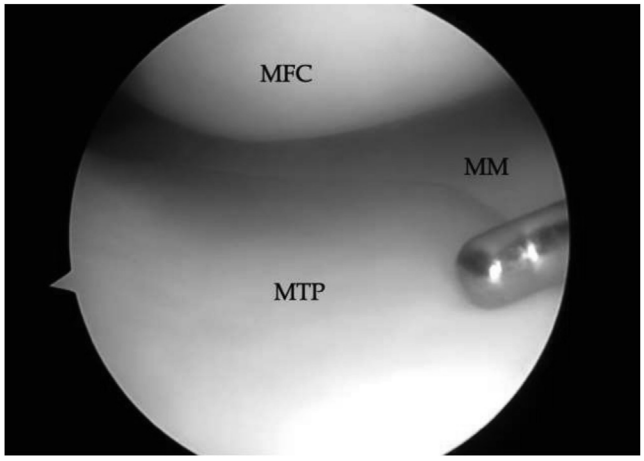

Fig 7. Arthroscopic view of the right knee from the anterolateral portal demonstrating a reduced medial meniscus (MM) and negation of drive-through sign following open repair of the meniscotibial ligament and superficial medial collateral ligament. (MFC, medial femoral condyle. MTP, medial tibial plateau.)

from the meniscus to the tibial plateau, resulting in the accelerated progression of medial compartmental osteoarthritis.[5-7] Therefore, recognition of these lesions is important based on both magnetic resonance imaging and arthroscopic assessment. Surgical management with repair of MTL tears is necessary to avoid detrimental short-term sequelae.[11-13] When coupled with severe valgus instability due to complete disruption of the sMCL, further strain on other structures such as the anterior cruciate ligament (ACL) may lead to further joint damage.[14]

The surgical technique described in this report allows for reduction of the medial meniscus through an open repair of a disrupted MTL. In a biomechanical cadaveric study, Smith et al.[5] found that not repairing MTL lesions was associated with significant increases in ACL strain; anterior laxity at 0°, 30°, and 90°; valgus laxity; and external rotation laxity. By repairing these MTL lesions, proper intra-articular anatomy can be restored, which may benefit patients, especially in the immediate postoperative period as they begin their rehabilitation protocol.

Isolated grade III sMCL lesions have historically been treated nonoperatively, but caution should be taken with nonoperative management, as in some cases grade III tears may result in residual valgus laxity and so MCL repair or reconstruction would be the better treatment option.[15] Distal Stener-type lesions with avulsion of the sMCL off its tibial attachment is a variant of a grade III lesion that needs direct surgical repair to restore valgus stability. In a systematic review including 18 studies (n = 1,534 cases), Shultz et al.[16] concluded that those patients with avulsion MCL injuries and Stener-type lesions may benefit from early repair due to the persisting valgus instability that may result from these lesions untreated. Apart from these investigations, a recent case series conducted on professional athletes to assess Stener-type injuries revealed that surgical intervention was linked to a high rate of return to the preinjury level of sports, exceptional functional performance, and minimal chances of recurrence during short-term follow-up.[17]

Through the same incision, the sMCL can be repaired with a combination of suture anchor fixation and internal brace augmentation, forming a construct that is biomechanically similar to a reconstruction.[5,18] In a biomechanical study, Mehl et al.[19] evaluated the effects of suture-tape augmentation in primary repair of sMCL and posterior oblique ligament (POL) injuries. The study revealed that cadavers with complete sMCL and POL avulsions that were treated with sMCL and POL repair with augmentation demonstrated nearly native valgus and rotational laxity, along with ACL strain resembling native conditions. Another biomechanical study, focusing on a combined ACL/MCL repair model, reported similar findings. Specifically, cadavers that underwent MCL repair with augmentation showed improved valgus and external rotation laxity compared with those that underwent MCL repair alone, without augmentation.[20]

In conclusion, this Technical Note describes the anatomic fixation of both the sMCL and medial

Table 2. Advantages and Disadvantages of the Technique

Advantages	Disadvantages
• Single medial incision • Primary/independent fixation and repair of the MTL and distal sMCL injuries • Anatomic repair of MTL and distal sMCL injuries • Primary superficial MCL repair + *Internal*Brace (Arthrex) augmentation allowing for similar strength to reconstruction • Early weight-bearing with accelerated postoperative rehabilitation program is allowed	• Potential cost of fixation with multiple anchors/suture tape • Need for open incision • Potential loss of motion if internal brace placed nonisometric or overtensioned

MTL, meniscotibial ligament; sMCL, superficial medial collateral ligament.

meniscus in the setting of a grade III sMCL avulsion with concomitant medial MTL injury.[21] Not only does it allow for an anatomic reduction, but since this is a completely open technique, there is the benefit of a faster surgical time. Furthermore, MCL biomechanics following internal brace augmentation allows the patient to be able to begin early weight-bearing with an accelerated postoperative rehabilitation program to help minimize muscle atrophy.[22,23]

The advantages and disadvantages are summarized in Table 2. The main disadvantages of this technique are the need for an open incision, the additional cost of fixation with multiple suture anchors, and loss of range of motion with improper final internal brace fixation.

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